

BIOFILTER PILOT PHOSPHORUS INVESTIGATION

MARCH 1, 2002

Biofilter Pilot Phosphorus Investigation

Background

The Biofilter Pilot Phosphorus Investigation has as its objective the investigation of the export of phosphorus observed from biofilter installations in the Caltrans Best Management Practice (BMP) Retrofit Pilot Program. The biofiltration swales and biofiltration strips have shown a negative removal of phosphorus during the three years of pilot monitoring, and it is hypothesized that the vegetation (*saltgrass*) used in the devices is transporting phosphorus from the soil and soil water to the surface environment. Saltgrass has a documented ability to transport salts from the subsurface and extrude them on the upper parts of the grass, which allows them to thrive in saline environments. This experiment is designed to determine whether this transport of salts from the subsurface to the surface might be responsible for the observed export of phosphorus during storm events as monitored in the Retrofit Pilot Program.

Experiment Sampling Program

Sample Collection

A field crew collected samples of Bermuda grass and saltgrass from various pilot sites. No rainfall had occurred in the prior seven days. Clean phosphorus-free containers were used to store the representative samples of Bermuda and saltgrass (preferred with a portion being green) cut from just above the soil level making sure that the entire height of the sprigs were included. To prevent sample contamination, disposal gloves were used, and cutting tools were rinsed and wiped prior to sample collections. Samples were collected from four BMP pilot sites (see Table 1). All pilot sites had biofilter installations except for the extended detention basin (EDB) at I-15 / SR-78 (ID: 111102), where other types of grass species were collected and served as a comparison to the Bermuda and saltgrass samples from pilot sites that had biofilter installations. The collected samples were placed in an ice-filled cooler until the sample collections at all four selected BMP pilot sites was completed and shipped overnight on the same day that they were collected to the designated laboratory for testing within 3 days of sample collection.

Table 1. Sampling Locations

WQ SITE NO.	LOCATION	BMP
111102	I-15 / SR-78	EXTENDED DETENTION BASIN (EDB) (northwest section of the EDB)
112205	SR-78 / MELROSE DRIVE	BIOFILTRATION SWALE (BSw) (midsection of the swale)
112206	I-5 / PALOMAR AIRPORT RD	BIOFILTRATION SWALE (BSw) (midsection of the swale)
112207B	CARLSBAD MAINTENANCE STATION	BIOFILTRATION STRIP (BSt) (midsection section of the strip)

Laboratory Testing

Approximately 15 grams of grass sample were placed in 1 liter of deionized (DI) water. Care was taken to keep the cut end of the grass samples from contacting the DI water since the cut end would not be exposed to water during a storm water event. The

samples were allowed to remain in the water for 1 hour. The DI water was then decanted and analyzed for total phosphorus and dissolved ortho-phosphate using EPA Method 365.3. Laboratory testing procedures were instructed to be in accordance with the document, *Guidance Manual: Stormwater Monitoring Protocols*, Caltrans, July 2000.

Results and Discussion

A total of eight samples were collected and analyzed for total phosphorus and dissolved ortho-phosphate. The total phosphorus and dissolved ortho-phosphate measured from each sample are shown in Table 2. The reporting limit for both total phosphorus and dissolved ortho-phosphate is 0.002 mg/L (ppm). The deionized water was used as blanks for base comparison. The deionized water was initially tested and reported as "ND ('Not Detected')" in both total phosphorus and dissolved ortho-phosphate. ND indicates the result was lower than the reporting limit and that ensures any detectable presence of phosphorus will be an indication of phosphorus introduced by the particular grass sample.

A photograph of the Bermuda grass is shown in Figure 1, and a sample of saltgrass collected from the biofiltration swale at Palomar Airport Road is shown in Figure 2.

Table 2 shows amounts of total phosphorus and dissolved ortho-phosphate from the samples collected. In three out of the four BMP pilot sites, higher concentration of total and dissolved ortho-phosphate were detected for saltgrass water sample as compared to Bermuda grass. It is hypothesized that saltgrass extrudes phosphorus on to the leaf surface, which can then come in contact with storm water runoff. For reference, the lab reports are attached in the appendix.

Table 2. Results of Total Phosphorus and dissolved Ortho-Phosphate Measurement.

WQ Site No.	Location	BMP	Sample Species Collected	Total Phosphorus mg/L (ppm)	Dissolved Ortho-Phosphate mg/L (ppm)
111102	I-15 / SR-78	Extended Detention Basin (EDB)	Bermuda	0.15	0.14
112205	SR-78 / Melrose Drive	Biofiltration Swale (BSw)	Bermuda	0.65	0.64
			Saltgrass	0.13	0.13
112206	I-5 / Palomar Airport Rd	Biofiltration Swale (BSw)	Bermuda	0.34	0.28
			Saltgrass	0.27	0.26
112207B	Carlsbad Maintenance Station	Biofiltration Strip (BSt)	Bermuda	0.20	0.20
			Saltgrass	0.15	0.14



Figure 1. Bermuda grass collected at I-15 / SR-78 EDB site.



Figure 2. A sample of saltgrass collected at the Carlsbad Maintenance Station.

Appendix. Laboratory Reports

FACSIMILE
TRANSMITTAL FORM



DATE 3/14/02 TIME 11:20 BILLING CODE 591

NUMBER OF PAGES (INCLUDING COVER SHEET) 7

TO: TERRENCE CHEN

COMPANY: ROF CONSULTING

FAX NUMBER: 949-586-6531

FROM: BOB SHELLQUIST

KINNETIC LABORATORIES, INC. CARLSBAD, CA

FAX NUMBER: (760) 438-2959

NOTES: ATTACHED ARE THE PRELIMINARY RESULTS OF
THE SALT AND BELMONTA GRASS SAMPLES YOU
SUBMITTED 3/14/02.

Bob

IF YOU EXPERIENCE ANY DIFFICULTY WITH THIS TRANSMISSION, PLEASE CALL (760) 438-8968.
KINNETIC LABORATORIES, INC. 5225 HAVENIDA ENCINAS CARLSBAD, CA 92008

BACTERIOLOGISTS
 Approved by State of California

SOIL CONTROL LAB

Tel: 831 724 5422
 FAX: 831 724-3188

Account Number
 161350-7-3344

ToxScan Inc.
 42 Hangar Way
 Watsonville, CA 95076

Reporting Date:
 March 13, 2002

Date Received: Water samples received 3/5/02
 ToxScan#: T-20163
 Report: Quantitative chemical analysis with results reported in mg/L (ppm)
 unless otherwise stated.

Sample Identification	Site ID	Weight Used (g)	Dissolved Ortho Phosphorus Found In Extract (as P)	Dissolved Ortho Phosphorus Corrected For Weight Used (as P)
111102BR2	7815 EDB	15.52	0.15	0.14
112205BR2	Melrose	13.10	0.56	0.64
112205SG2	Melrose	14.40	0.12	0.13
112205BR2	Palomar	15.16	0.29	0.26
112205SG2	Palomar	12.88	0.21	0.25
1122076T_6R2	Carlsbad Strip	16.58	0.22	0.20
1122076T_5R2	Carlsbad Strip	12.38	0.12	0.14

Prep Batch ID: DirP_030502
 Analysis Batch ID: DirP_030502
 Method of Analysis: EPA 385.3
 Reporting Limit: 0.002 mg/L

The instructions that came with the samples said to take approximately 15g of grass to 1L of DI water. We didn't have exactly 15g of grass for every sample, so we have listed the actual weight used above. Regardless of the weight used we extracted with 1l of DI water. Above I have listed the concentration found in the extract and then I have included a column that calculates what we would have found if we had used exactly 15g for each extract.

APPROVED BY: [Signature]
and
BACTERIOLOGISTS
Approved by State of California

Tel: 831 724-5422
FAX: 831 724-3188

SOIL CONTROL LAB



Account Number:
161350-7-3344

ToxScan Inc.
42 Hangar Way
Watsonville, CA 95076

Reporting Date:
March 13, 2002

Preparation Batch Quality Control Report

ToxScan#: T-20163

Dissolved
Phosphorus
(as P)

Blank	ND
Standard Reference Material (SRM)	ERA Nutrients 99104
SRM Lot #	4.96
Value Found	4.91
Certified Value	100.9
SRM Recovery (%)	

Preparation Batch ID:	DisP_030502
Date/Time of Preparation:	03/05/02 13:00
Method of Analysis:	EPA 365.3
Target Reporting Limit:	0.002 mg/L

Please Note:

- The target reporting limit is the reporting limit used if the sample can be run undiluted and there are no matrix effects for each particular sample. Each sample listed on the report page has it's own reporting limit listed that accounts for dilution (i.e. a sample that is diluted x10 has a reporting limit that is also multiplied by a x10 factor).
- ND ("Not Detected") means the result is lower than the reporting limit

BACTERIOLOGISTS
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Tel: 831 724-5422
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SOIL CONTROL LAB



Account Number:
161350-7-3244

ToxScan Inc.
42 Hangar Way
Watsonville, CA 95076

Reporting Date:
March 13, 2002

Analysis Batch Quality Control Report

ToxScan#: T-20163

Dissolved
Phosphorus
(as P)

Duplicates

ToxScan T# which was duplicated
Rep1
Rep2
Relative Percent Difference (RPD)

T-20163-07
0.143
0.145
2.63

Matrix Spike/Matrix Spike Duplicate (MS/MSD)

ToxScan T# which was spiked
Original Concentration Found
Spike Amount
MS Concentration Found
MS Recovery (%)
MSD Concentration Found
MSD Recovery (%)

T-20163-07
0.149
0.121
0.269
99.1
0.271
100.7

Analysis Batch ID:
Date/Time of Analysis:
Method of Analysis:
Target Reporting Limit:

DISP_030502
03/13/02 13:00
EPA 365.3
0.002 mg/L

Please Note:

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- ND ("Not Detected") means the result is lower than the reporting limit.

BACTERIOLOGISTS
Approved by State of California

Tel: 831 724-5422
FAX: 831 724-3188

SOIL CONTROL LAB



Account Number:
181350-7-3344

ToxScan Inc.
42 Hangar Way
Watsonville, CA 95076

Reporting Date:
March 13, 2002

Date Received: Water samples received 3/5/02
ToxScan#: T-20163
Report: Quantitative chemical analysis with results reported in mg/L (ppm)
unless otherwise stated.

Sample Identification	Site ID	Weight Used (g)	Total Phosphorus Found in Extract (as P)	Total Phosphorus Corrected For Weight Used (as P)
111102BR2	7815 EDB	15.52	0.16	0.15
112205BR2	Metrose	13.10	0.57	0.65
112205SG2	Metrose	14.40	0.13	0.13
112206BR2	Palomar	15.16	0.34	0.34
112206BR2	Palomar	12.88	0.23	0.27
112207S1_BR2	Carlsbad Strip	16.58	0.22	0.20
112207S1_SG2	Carlsbad Strip	12.38	0.13	0.15

Prep Batch ID: TotP_030602
Analysis Batch ID: TotP_030602
Method of Analysis: EPA 365.3
Reporting Limit: 0.002 mg/l

The instructions that came with the samples said to take approximately 15g of grass to 1L of DI water. We didn't have exactly 15g of grass for every sample, so we have listed the actual weight used above. Regardless of the weight used we extracted with 1L of DI water. Above I have listed the concentration found in the extract and then I have included a column that calculates what we would have found if we had used exactly 15g for each extract.

APPLIED MICROBIOLOGY
LABORATORY
BACTERIOLOGISTS
Approved by State of California

Tel: 831 724-5422
FAX: 831 724-3188

SOIL CONTROL LAB



Account Number
161350-7-3344

ToxScan Inc.
42 Hanger Way
Watsonville, CA 95076

Reporting Date:
March 13, 2002

Preparation Batch Quality Control Report

ToxScan#: T-20163

	<u>Total Phosphorus (as P)</u>
Blank	ND
Standard Reference Material (SRM)	
SRM Lot #	EPA Demand 99108
Value Found	2.45
Certified Value	2.42
SRM Recovery (%)	101.2
Preparation Batch ID:	101P_030502
Date/Time of Preparation:	03/05/02 12:30
Method of Analysis:	EPA 365.3
Target Reporting Limit:	0.002 mg/L

Please Note:

- 1. The target reporting limit is the reporting limit used if the sample can be run undiluted and there are no matrix effects for each particular sample. Each sample listed on the report page has its own reporting limit listed that accounts for dilution (i.e. a sample that is diluted x10 has a reporting limit that is also multiplied by a x10 factor).
- 2. ND ("Not Detected") means the result is lower than the reporting limit.

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LABORATORY SOIL CONTROL
BACTERIOLOGISTS
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SOIL CONTROL LAB

Tel: 831 724-5422
FAX: 831 724-3188

Account Number:
181350-7-3344

ToxScan Inc.
42 Hangar Way
Watsonville, CA 95076

Reporting Date:
March 13, 2002

Analysis Batch Quality Control Report

ToxScan#: T-20163

	Total Phosphorus (as P)
Duplicates	
ToxScan T# which was duplicated	T-20163-07
Rep1	0.155
Rep2	0.161
Relative Percent Difference (RPD)	4.00
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	
ToxScan T# which was spiked	T-20163-07
Original Concentration Found	0.165
Spike Amount	0.121
MS Concentration Found	0.268
MS Recovery (%)	94.2
MSD Concentration Found	0.289
MSD Recovery (%)	110.2

Analysis Batch ID:	ToxP_030602
Date/Time of Analysis:	03/06/02 06:05
Method of Analysis:	EPA 365.5
Target Reporting Limit:	0.002 mg/L

Please Note:

- 1- The target reporting limit is the reporting limit used if the sample can be run undiluted and there are no matrix affects for each particular sample. Each sample listed on the report page has it's own reporting limit listed that accounts for dilution (i.e. a sample that is diluted x10 has a reporting limit that is also multiplied by a x10 factor).
- 2- ND (" Not Detected") means the result is lower than the reporting limit.

[Handwritten Signature]
TOTAL P.00